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ADDRESS

OF

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THE RETIRING PRESIDENT OF THE ASSOCIATION.

GENTLEMEN AND LADIES OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE:—

THE founders of science in America, and the other great students of nature, who have in previous years occupied the elevated position in which I now stand, have addressed you upon many momentous subjects. In fulfilling the final duty, assigned to your Presidents by the laws of the Association, some have spoken to you in solemn and wise words concerning the duties and privileges of men of science: and the converse duties of the nation towards those earnest and disinterested promoters of knowledge. Others again have given you the history of the development of their respective branches of study, and their present condition, and have, in eloquent diction, commended to your gratitude those who have established on a firm foundation the basis of our modern systems of investigation.

The recent changes in our Constitution, by which you are led to expect from your two Vice-presidents, and from the Chairman of the Chemical Subsection, addresses on the progress made during the past year, restrain me from invading their peculiar fields of

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labor, by alluding to scientific work which has been accomplished since our last meeting. While delicacy forbids me from so doing, I am equally debarred from repeating to you the brief sketch I endeavored to give at a former meeting[1] of the history, and present condition of Entomology in the United States.

But it has appeared to me that a few thoughts, which have impressed themselves on my mind, touching the future results to be obtained from certain classes of facts, not yet fully developed, on account of the great labor required for their proper comparison, may not be without value. Even if the facts be not new to you, I hope to be able, with your kind attention, to present them in such way as to be suggestive of the work yet to be done.

It has been perhaps said, or at least it has been often thought, that the first mention of the doctrine of evolution, as now admitted to a greater or less degree by every thinking man, is found in Ecclesiastes, i, 9:—

"The thing that hath been is that which shall be; and that which is done is that which shall be done; and there is no new thing under the sun. Is there anything whereof it may be said, See, this is new? It hath been already of old time, which was before us."

Other references to evolutionary views in one form or another occur in the writings of several philosophers of classic times, as you have had recent cause to remember.

Whether these are to be considered as an expression of a perfect truth in the very imperfect language which was alone intelligible to the nation to whom this sacred book was immediately addressed on the one hand; and the happy guesses of philosophers, who by deep intuition had placed themselves in close sympathy with the material universe, on the other hand, I shall not stop to enquire. The discussion would be profitless, for modern science in no way depends for its magnificent triumphs of fact and thought upon any utterances of the ancients. It is the creation of patient intelligent labor of the last two centuries, and its results can be neither confuted nor confirmed by anything that was said, thought or done at an earlier period. I have merely referred to these indications of doctrines of evolution to recall to your minds that the two great schools of thought, which now divide philosophers, have existed from very remote times. They are,

[1] Proceedings Am. Assoc. Adv. Sc. xxi (Portland).

therefore, in their origin, probably independent of correct scientific knowledge.

You have learned from the geologists, and mostly from those of the present century, that the strata of the earth have been successively formed from fragments more or less comminuted by mechanical action, more or less altered by chemical combination and molecular rearrangement. These fragments were derived from strata previously deposited, or from material brought up from below, or even thrown down from above, or from the débris of organic beings which extracted their mineral constituents from surrounding media. Nothing new has been added, everything is old: only the arrangement of the parts is new, but in this arrangement definite and recognizable unchanged fragments of the old frequently remain. Geological observation is now so extended and accurate that an experienced student can tell from what formation, and even from what particular locality these fragments have been derived.

I wish to show that this same process has taken place in the organic world, and that by proper methods we can discover in our fauna and flora the remnants of the inhabitants of former geologic times, which remain unchanged, and have escaped those influences of variation which are supposed to account for the differences in the organic beings of different periods.

Should I succeed in this effort, we will be hereafter enabled in groups of animals which are rarely preserved in fossil condition, to reconstruct, in some measure, the otherwise extinct faunæ, and thus to have a better idea of the sequence of generic forms in time. We will also have confirmatory evidence of certain changes which have taken place in the outline of the land and the sea. More important still, we will have some indications of the time when greater changes have occurred, the rock evidence of which is now buried at the bottom of the ocean, or perhaps entirely destroyed by erosion and separations. Of these changes, which involved connections of masses of land, no surmise could be made, except through evidence to be gained in the manner of which I am about to speak.

My illustrations will naturally be drawn from that branch of zoology, with which I am most familiar; and it is indeed to your too partial estimate of my studies in that science, that I owe the privilege of addressing you on the present occasion.

There are, as you know, a particular set of Coleoptera which affect the seashore; they are not very numerous at any locality, but among them are genera which are represented in almost every country of the globe. Such genera are called cosmopolitan, in distinction to those which are found only in particular districts. Several of these genera contain species which are very nearly allied, or sometimes in fact undistinguishable and therefore identical along extended lines of coast.

Now it happens that some of these species, though they never stray from the ocean shore inland, are capable of living upon similar beaches on fresh water lakes, and a few are found in localities which are now quite inland.

To take an example, or rather several examples together, for the force of the illustration will be thereby greatly increased.

Along the whole of the Atlantic, and the greater part of the Pacific coast of the United States, is found in great abundance on sand beaches, a species of Tiger-beetle, *Cicindela hirticollis*, an active, winged and highly predaceous insect; the same species occurs on the sand beaches of the great lakes, and were it confined to these and similar localities, we would be justified in considering it as living there in consequence solely of the resemblance in the conditions of existence. But, it is also found, though in much less abundance, in the now elevated region midway between the Mississippi and Rocky Mountains. Now, this is the part of the continent which, after the division of the great intercontinental gulf in Cretaceous times, finally emerged from the bed of the sea, and was in the early and middle Tertiary converted into a series of immense fresh water lakes. As this insect does not occur in the territory extending from the Atlantic to beyond the western boundary of Missouri, nor in the interior of Oregon and California, I think that we should infer that it is an unchanged survivor of the species which lived on the shores of the Cretaceous ocean, when the intercontinental gulf was still open, and a passage existed, moreover, towards the south-west, which connected with the Pacific.

The example I have given you of the geographical distribution of *Cicindela hirticollis* would be of small value, were it an isolated case; nor would I have thought it worthy of occupying your time, on an occasion like this, which is justly regarded as one for the communication of important truth. This insect, which I have selected as a type for illustrating the methods of investigation to

which I invite your attention, is, however, accompanied more or less closely by other Coleoptera, which like itself are not particular as to the nature of their food, so long as it be other living insects, and apparently are equally indifferent to the presence of large bodies of salt water. First, there is *Cicindela lepida*, first collected by my father, near Trenton, New Jersey, afterwards found on Coney Island, near New York, and received by me from Kansas and Wisconsin; not, however, found west of the Rocky Mountains. This species, thus occurring in isolated and distant localities, is probably in process of extinction, and may or may not be older than *C. hirticollis*. I am disposed to believe, as no representative species occurs on the Pacific coast, and from its peculiar distribution, that it is older. Second, there is *Dyschirius pallipennis*, a small Carabide, remarkable among other species of the genus by the pale wing covers, usually ornamented with a dark spot. This insect is abundant on the Atlantic coast from New York to Virginia, unchanged in the interior parts of the Mississippi valley, represented at Atlantic City, New Jersey, by a larger and quite distinct specific form, *C. sellatus*, and on the Pacific coast by two or three species of larger size and different shape, which in my less experienced youth I was disposed to regard as a separate genus *Akephorus*. This form is, therefore, in a condition of evolution,—how, I know not,—our descendants may. The Atlantic species are winged, the Pacific ones, like a large number of insects of that region are without wings.

Accompanying these are Coleoptera of other families, which have been less carefully studied, but I will not trespass upon your patience by mentioning more than two. *Bledius pallipennis* (*Staphylinidæ*) is found on salt marshes near New York, on the Southern sea coast, and in Kansas,—*Ammodonus fossor*, a wingless Tenebrionide, Trenton, seashore near New York, and valley of Mississippi at St. Louis; thus nearly approximating *Cicindela lepida* in distribution.

We can thus obtain by a careful observation of the localities of insects, especially such as affect seashore or marsh, and those which being deprived of their favorite surroundings, have shown, if I may so express myself, a patriotic clinging to their native soil, most valuable indications in regard to the time at which their unmodified ancestors first appeared upon the earth. For it is obvious that no tendency to change in different directions by " nu-

merous successive slight modifications"[1] would produce a uniform result in such distant localities, and under such varied conditions of life. Properly studied, these indications are quite as certain as though we found the well preserved remains of these ancestors in the mud and sand strata upon which they flitted or dug in quest of food.

Other illustrations of survivals from indefinitely more remote times I will also give you, from the Coleopterous fauna of our own country, though passing time admonishes me to restrict their number.

To make my remarks intelligible, I must begin by saying that there are three great divisions of Coleoptera, which I will name in the order of their complication of structural plan: 1. Rhynchophora; 2. Heteromera; 3. Ordinary or normal Coleoptera; the last two being more nearly allied to each other than either is to the first. I have in other places exposed the characters of these divisions, and will not detain you by repeating them.

From Palæontological evidence derived from other branches of zoology, we have a right to suppose, if this classification be correct, that these great types have been introduced upon the earth in the order in which I have named them.

Now, it is precisely in the first and second series that the most anomalous instances of geographical distribution occur; that is to say, the same or nearly identical genera are represented by species in very widely separated regions, without occurring in intermediate or contiguous regions. Thus there is a genus *Emeax*, founded by Mr. Pascoe, upon an Australian species, which, when I saw it, I recognized as belonging to *Nyctoporis*, a California genus, established many years before; and in fact barely specifically distinct from *N. galeata*. Two other examples are *Othnius* and *Eupleurida*, United States genera, which are respectively equivalent to *Elacatis* and *Ischalia*, found in Borneo. Our native genera *Eurygenius* and *Toposcopus*, are represented by scarcely different forms in Australia. All these belong to the second series (*Heteromera*), and the number of examples might be greatly increased with less labor on my part than patience on yours.

A single example from the Rhynchophora, and I will pass to another subject.

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[1] Origin of Species, 1869, 227.

On the sea coast of California, extending to Alaska, is a very anomalous insect, whose affinities are difficult to discern, called *Emphyastes fucicola*, from its occurrence under the sea-weed cast up by the waves. It is represented in Australia by several species of a nearly allied genus Aphela, found in similar situations.

In all entomological investigations relating to geographical distribution, we are greatly embarrassed by the multitude of species, and by the vague and opinionative genera founded upon characters of small importance. The Coleoptera alone, thus far described, amount to over 60,000 so-called species, and there are from 80,000 to 100,000 in collections. Under these circumstances it is quite impossible for one person to command either the time or the material to master the whole subject, and from the laudable zeal of collectors to make known what they suppose to be new objects, an immense amount of synonymy must result. Thus in the great Catalogus Coleopterorum of Gemminger and Harold, a permanent record of the untiring industry of those two excellent entomologists, species of the genus *Trechicus* founded by me upon a small North American insect, are mentioned under five generic names, only one of which is recognized as a synonym of another. These generic headings appear in such remote pages of the volume as 135, 146 and 289.

The two closely allied genera of Rhynchophora mentioned above are separated by no less than 168 pages.

It is therefore plain, that before much progress can be made in the line of research which I have proposed to you, whereby we may recover important fragments of the past history of the earth, Entomology must be studied in a somewhat different manner from that now adopted. The necessity is every day more apparent that descriptions of heterogeneous material are rather obstructive than beneficial to science, except in the case of extraordinary forms likely to give information concerning geographical distribution or classification. Large typical collections affording abundant material for comparison, for the approximation of allied forms, and the elimination of doubtful ones must be accumulated; and in the case of such perishable objects, as those we are now dealing with, must be placed where they can have the protecting influences both of climate and personal care.

At the same time, for this investigation, the study of insects is peculiarly suitable; not only on account of the small size, ease of collecting, and little cost of preserving the specimens, but because

from their varied mode of life in different stages of development, and perhaps for other reasons, the species are less likely to be destroyed in the progress of geological changes.[1] Cataclysms and submergences, which would annihilate the higher animals, would only float the temporarily asphyxiated insect, or the tree trunks containing the larvæ and pupæ to other neighboring lands. However that may be, I have given you some grounds for believing, that many of the species of insects now living existed in the same form before the appearance of any living genera of mammals, and we may suppose that their unchanged descendants will probably survive the present mammalian fauna, including our own race.

I may add, moreover, that some groups, especially in the Rhynchophora, which, as I have said above, I believe to be the earliest introduced of the Coleoptera, exhibit with compact and definite limits, and clearly defined specific characters, so many generic modifications, that I am compelled to think that we have in them an example of the long sought unbroken series, extending in this instance from early mesozoic to the present time, and of which very few forms have become extinct.

I have used the word *species* so often, that you will doubtless be inclined to ask, what, then, is understood by a species? Alas! I can tell you no more than has been told recently by many others. It is an assemblage of individuals, which differ from each other by very small or trifling and inconstant characters, of much less value than those in which they differ from any other assemblage of individuals. Who determines the value of these characters? The experienced student of that department to which the objects belong. Species are, therefore, those groups of individuals representing organic forms which ARE RECOGNIZED as such by those who from natural power and education are best qualified to judge.

You perceive, therefore, that we are here dealing with an entirely different kind of information from that which we gain from the physical sciences; everything there depends on accurate observation, with strict logical consequences derived therefrom. Here the basis of our knowledge depends equally on accurate and trained observation, but the logic is not formal but perceptive.

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[1] For a fuller discussion of these causes, and of several other subjects which are briefly mentioned in this address, the reader may consult an excellent memoir by my learned friend, Mr. Andrew Murray, "On the Geographical Relations of the Chief Coleopterous Faunæ." (Journal of Linnæan Society, Zoology, Vol. xi.)

This has been already thoroughly recognized by Huxley[1] and Helmholtz,[2] and others, but we may properly extend the inquiry into the nature and powers of this æsthetic perception somewhat farther. For it is to this fundamental difference between biological and physical sciences that I will especially invite your attention.

Sir John Lubbock,[3] quoting from Oldfield[4] mentions that certain Australians "were quite unable to realize the most vivid artistic representations. On being shown a picture of one of themselves, one said it was a ship, another a kangaroo, not one in a dozen identifying the portrait as having any connection with himself."

These human beings, therefore, with brains very similar to our own, and as is held by some persons, potentially capable of similar cultivation with ourselves, were unable to recognize the outlines of even such familiar objects as the features of their own race. Was there any fault in the drawing of the artist? Probably not. Or in the eye of the savage? Certainly not, for that is an optical instrument of tolerably simple structure, which cannot fail to form on the retina an accurate image of the object to which it is directed. Where then is the error? It is in the want of capacity of the brain of the individual (or rather the race in this instance) to appreciate the resemblance between the outline, the relief, the light and shade of the object pictured, and the flat representation in color: in other words, a want of "artistic tact" or æsthetic perception.

A higher example of a similar phenomenon I have myself seen: many of you too have witnessed it, for it is of daily occurrence. It is when travellers in Italy having penetrated to the inmost chamber of the Temple of Art, even the Hall of the Tribune at Florence, stand in presence of the most perfect works of Art, which it has been given to man to produce, and gaze upon them with the same

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[1] "A species is the smallest group to which distinctive and invariable characters can be assigned." (Principles and Methods of Palæontology, Smithsonian Report, 1869, 378).

[2] "I do not mean to deny that, in many branches of these sciences, an intuitive perception of analogies and a certain artistic tact play a conspicuous part. In natural history . . . . . it is left entirely to this tact, without a clearly definable rule, to determine what characteristics of species are important or unimportant for purposes of classification, and what divisions of the animal or vegetable kingdom are more natural than others." (Relation of the Physical Sciences to Science in General. Smiths. Report. 1871, 227.)

[3] Prehistoric Times, p. 440.

[4] On the Aborigines of Australia. Trans. Ethnological Soc. New Series, Vol. 3.

indifference that they would show to the conceptions of mediocre artists exhibited in our shops.

Perhaps they would even wonder what one can find to admire in the unrivalled collection, which is there assembled.

There is surely wanting in the minds of such persons that high, æsthetic sense, which enables others to enter into spiritual harmony with the great artists whose creations are before them.

Creations I said, and I use the word intentionally. If there is one power of the human soul, which more nearly than any other approaches the faculty of creation, it is that by which the almost inspired artist develops out of a rude block of stone, or out of such mean materials as canvass and metallic pastes of various colors, figures which surpass in beauty, and in power of exciting emotion, the objects they profess to represent.

Yet these unæsthetic and nonappreciative persons are just as highly educated, and in their respective positions as good and useful members of the social organism as any that may be found. I maintain only, they would never make good students of biology.

In like manner, by way of illustrating the foregoing observations, there are some, who in looking at the phenomena of the external Universe, may recognize only Chance, or the "fortuitous concourse of atoms," producing certain resultant motions. Others, having studied more deeply the nature of things, will perceive the existence of laws, binding and correlating the events they observe. Others again, not superior to the latter in intelligence, nor in power of investigation, may discern a deeper relation between these phenomena, and the indications of an intellectual or æsthetic or moral plan, similar to that which influences their own actions, when directed to the attaining of a particular result.

These last will recognize in the operations of nature the direction of a Human Intelligence, greatly enlarged, capable of modifying at its will influences beyond our control; or they will appreciate in themselves a resemblance to a superhuman intelligence which enables them to be in sympathy with its actions.

Either may be true in individual instances of this class of minds; one or other must be true; I care not which, for to me the propositions are in this argument identical, though in speculative discussions, they may be regarded as at almost the opposite poles of religious belief. All that I plead for is, that those who have not this perceptive power, and who in the present condition of

scientific discussion are numerically influential, will have tolerance for those who possess it; and that the ideas of the latter may not be entirely relegated to the domain of superstition and enthusiasm.

In the case of the want of perception of the Australian, a very simple test can be applied. It is only to photograph the object represented by the artist, and compare the outlines and shades of the photograph, with those of the picture. If they accord within reasonable limits the picture is correct to that extent; at least, however bad the artist, the human face could never be confounded with a ship, or a kangaroo.

Can we apply a similar test to the works of nature? I think we can. Suppose that man,—I purposely use the singular noun to indicate that all human beings of similar intelligence and education working towards a definite end, will work in a somewhat similar manner,—suppose, then I say, that man, endeavoring to carry out some object of importance, devises a method of so doing, and creates for that purpose a series of small objects, and we find that these small objects naturally divide and distribute themselves in age and locality, in a similar manner to that in which the species of a group of organisms are divided in space, and distributed in time; and that the results of man's labor are thus divided and distributed on account of the necessary inherent qualities of his intelligence and methods of action, is not the resemblance between human reason and the greater powers which control the manifestations of organic nature apparent?

I now simply present to you this investigation. Time is wanting for me to illustrate it by even a single example, but I feel sure that I have in the minds of some of you already suggested several applications of it to the principle I wish to teach:—the resemblance in the distribution of the works of nature to that of human contrivances evolved for definite purposes.

If this kind of reasoning commends itself to you, and you thus perceive resemblances in the actions of the Ruler of the Universe to those of our own race, when prompted by the best and highest intellectual motives, you will be willing to accept the declaration of the ancient text, "He doeth not evil, and abideth not with the evil inclined. Whatever he hath done is good;"[1] or that

[1] Desatir, p. 2.

from our own canon of Scripture: "With him is wisdom and strength, he hath counsel and understanding."[1]

The æsthetic character of Natural History, therefore, prevents the results of its cultivation from being worked out with the precision of a logical machine, such as with correct data of observation and calculation would be quite sufficient to formulate the conclusions of physical investigation. According as the perception of the relations of organic beings among themselves becomes more and more enlarged, the interpretation of these relations will vary within limits; but we will be continually approximating higher mental or spiritual truth.

This kind of truth can never be revealed to us by the study of inorganic aggregations of the universe. The molar, molecular and polar forces, by which they are formed, may be expressed, so far as science has reduced them to order, by a small number of simply formulated laws, indicative neither of purpose nor intelligence, when confined within inorganic limits. In fact, taking also the organic world into consideration, we as yet see no reason why the number of chemical elements known to us should be as large as it is, and go on increasing almost yearly with more minute investigations. To all appearance, the mechanical and vital structure of the universe would remain unchanged, if half of them were struck out of existence.

Neither is there any evidence of intelligence or design in the fact that the side of the moon visible to us exhibits only a mass of volcanoes.

Yet upon the earth, without the volcano and the earthquake, and the elevating forces of which they are the feeble indications, there would be no permanent separation of land and water; consequently no progress in animal and vegetable life beyond what is possible in the ocean. To us, then, as sentient beings, the volcano and the earthquake, viewed from a biological standpoint, have a profound significance.

It is indeed difficult to see in what manner the student of purely physical science is brought to a knowledge of any evidences of intelligence in the arrangement of the Universe. The poet, inspired by meditating on the immeasurable abyss of space, and the transcendent glories of the celestial orbs has declared,

"The undevout astronomer is mad."

[1] Job, xii, 13.

and his saying had a certain amount of speciousness, on account of the magnitude of the bodies and distances with which the student of the stars is concerned. This favorite line is, however, only an example of what an excellent writer has termed "the unconscious action of volition upon credence," and it is properly in the correlations of the inorganic with the organic world, that we may hope to exhibit, with clearness, the adaptations of plan prefigured and design executed.

In the methods and results of investigation, the mathematician differs from both the physicist and the biologist. Unconfined like the former, by the few simple relations by which movements in the inorganic world are controlled, he may not only vary the form of his analysis, almost at pleasure, making it more or less transcendental in many directions, but he may introduce factors or relations, apparently inconceivable in real existences, and then interpret them into results quite as real as those of the legitimate calculus with which he is working, but lying outside of its domain.

If biology can ever be developed in such manner that its results may be expressed in mathematical formulæ, it will be the pleasing task of the future analyst, to ascertain the nature of the inconceivable (or imaginary as they are termed in mathematics) quantities which must be introduced when changes of form or structure take place. Such will be analytical morphology, in its proper sense; but it is a science of the future, and will require for its calculus a very complex algebra.

In the observation of the habits of inferior animals, we recognize many complications of action, which though directed to the accomplishment of definite purposes, we do not entirely comprehend. They are, in many instances, not the result of either the experience of the individual, or the education of its parents, who in low forms of animals frequently die before the hatching of the offspring. These actions have been grouped together, whether simple or complex, as directed by what we are pleased to call instinct, as opposed to reason. Yet there is every gradation between the two.

Among the various races of dogs, the companions of man for unnumbered centuries, we observe not only reasoning powers of a rather high order, but also distinct traces of moral sentiments, similar to those possessed by our own race. I will give no examples, for many may be found in books with which you are familiar.

Actions evincing the same mental attributes are also noticed in wild animals, which have been tamed. You will reply, that these qualities have been developed by human education; but not so, there must have been a latent capacity in the brain to receive the education, and to manifest the results by the modification of the habits. Now it is because we are vertebrates, and the animals of which I have spoken are vertebrates, that we understand, though imperfectly, their mental processes, and can develop the powers that are otherwise latent. Could we comprehend them more fully we would find, and we do find from time to time in the progress of our inquiries, that what was classed with instinct is really intellection.

When we attempt to observe animals belonging to another sub-kingdom, Articulata, for instance, such as bees, ants, termites, etc., which are built upon a totally different plan of structure, having no organ in common with ourselves, the difficulty of interpreting their intellectual processes, if they perform any, is still greater. The purposes of their actions we can only divine by their results. But anything more exact than their knowledge of the objects within their scope, more ingenious than their methods for using those objects, more complex, yet well devised than their social and political systems, it is impossible to conceive.

We are not warranted in assuming that these actions are instinctive, which if performed by a vertebrate we would call rational. Instead of concealing our ignorance under a word which thus used, comes to mean nothing, let us rather admit the existence here of a rational power, not only inferior to ours, but also different.

Thus proceeding, from the highest forms in each type of animal life to the lower, and even down to the lowest, we may be prepared to advance the thesis, that all animals are intelligent, in proportion to the ability of their organization to manifest intelligence to us, or to each other; that wherever there is voluntary motion, there is intelligence:— obscure it may be, not comprehended by us, but comprehended by the companions of the same low grade of structure.

However this may be, I do not intend to discuss the subject at present, but only wish in connection with this train of thought to offer two suggestions.

The first is, that by pursuing different courses of investigation in biology, we may be led to opposite results. Commencing with

the simplest forms of animal life, or with the embryo of the higher animals, it may be very difficult to say at what point intelligence begins to manifest itself; our attention is concentrated, therefore, upon those functions which appear to be the result of purely mechanical arrangements, acted upon by external stimuli. The animal becomes to our perception an automaton, and in fact, by excising some of the nervous organs last developed in its growth, we can render an adult animal an automaton, capable of performing only those habitual actions to which its brain, when in perfect condition, had educated the muscles of voluntary motion. On the other hand, commencing with the highest group in each type, and going downwards, either in structural complication, or in age of individual, it is impossible to fix the limit at which intelligence ceases to be apparent.

I have in this subject, as in that of tracing the past history of our insects, in the first part of this address, preferred the latter mode of investigation; taking those things which are nearest to us in time or structure, as a basis for the study of those more remote.

The second consideration is, since it is so difficult for us to understand the mental processes, whether rational or instinctive (I care not by what name they are called), of beings more or less similar, but inferior to ourselves; we should exercise great caution when we have occasion to speak of the designs of One who is infinitely greater. Let us give no place to the crude speculations of would-be-teleologists, who are indeed, in great part refuted already by the progress of science, which continually exhibits to us higher and more beautiful relations between the phenomenon of Nature "than it hath entered into the mind of man to conceive." Let not our vanity lead us to believe that because God has deigned to guide our steps a few paces on the road of truth, we are justified in speaking as if He had taken us into intimate companionship, and informed us of all His counsels.

If I have exposed my views on these subjects to you in an acceptable manner, you will perceive that in minds capable of receiving such impressions, biology can indicate the existence of a creative or directive power, possessing attributes, some of which resemble our own, and controlling operations which we may feebly comprehend. Thus far Natural Theology, and no farther.

What then is the strict relation of Natural History or biology to that great mass of learning and influence which is commonly

called Theology; and to that smaller mass of belief and action which is called Religion?

Some express the relation very briefly, by saying that Science and Religion are opposed to each other. Others again that they have nothing in common. These expressions are true of certain classes of minds; but the greater number of thinking and educated persons see, that though the ultimate truths taught by each are of quite distinct nature, and can by no means come in conflict, inasmuch as they have no point in common; yet so far as these truths are embodied in human language, and manipulated by human interests, they have a common dominion over the soul of man. According to the method of their government, they may then come into collision even as the temporal and spiritual sovereigns of Japan occasionally did, before the recent changes in that country.

In answering the query above proposed, it will be necessary to separate the essential truths of religion from the accessories of tradition, usage, and most of all, organizations and interpretations, which have in the lapse of time gathered around the primitive or revealed truth.

With the latter, the scientific man must deal exactly like other men, he must take it, or reject it, according to his spiritual gifts; but he must not, whatever be his personal views, discuss it or assail it *as a man of science*, for within his domain of investigation it does not belong.

With regard to the accessories of traditions, interpretations, etc., our answer may be clearer, when we have briefly reviewed some recent events in what has been written about as the Conflict of Religion and Science. Some centuries ago, great theological disgust was produced by the announcement that the sun and not the earth was the centre of the planetary system. A few decades ago profound dissatisfaction was shown that the evidence of organic life on the planet was very ancient. Recently some annoyance has been exhibited because human remains have been found in situations where they ought not to have been, according to popularly received interpretations; and yet more recently much apprehension has been felt at the possible derivation of man from some inferior organism; an hypothesis framed simply because in the present condition of intellectual advancement, no other can be suggested.

Yet all these facts, but the last, which still is an opinion, have been accepted, after more or less bitter controversy on both sides, and the fountain of spiritual truth remains unclouded and undiminished. New interpretations for the sacred texts, supposed to be in conflict with the scientific facts, have been sought and found without difficulty. These much feared facts have, moreover, given some of the strongest and most convincing illustrations to modern exhortation and religious instruction.

Thus, then, we see that the influence of Science upon Religion, has been beneficial. Scholastic interpretations founded upon imperfect knowledge, or no knowledge, but mere guess, have been replaced by sound criticism of the texts, and their exegesis in accordance with the times and circumstances for which they were written.

It must be conceded by fair minded men of both sides that these controversies were carried on at times with a rudeness of expression and bitterness of feeling now abhorrent to our usages. The intellectual wars of those days partook of the brutality of physical war, and the horrors of the latter, as you know, have been ameliorated only within very few years.

I fear that the unhappy spirit of contention still survives, and that there are yet a few who fight for victory rather than for truth. The deceptive spirit of Voltaire still buds forth occasionally; he, who, as you remember, disputed the organic nature of fossil shells, because in those days of schoolmen, their occurrence on mountains would be used by others as a proof of a universal Noachian deluge. The power of such spirits is fortunately gone for any potent influence for evil, gone with the equally obstructive influence of the scholastics with whom they formerly contended.

Since then, there is no occasion for strict Science and pure Religion to be in conflict, how shall the peace be kept between them?

By Toleration and Patience. Toleration towards those who believe less than we do, in the hope that they, by cultivation or inheritance of æsthetic perception, will be prepared to accept something more than Matter and Energy in the Universe, and to believe that Vitality is not altogether undirected Colloid Chemistry.

Toleration also towards those who, on what we think misunderstood or insufficient evidence, demand more than we are prepared to admit, in the hope that they will revise additional texts which

seem to conflict, or may hereafter conflict with facts deduced from actual study of Nature, and thus prepare their minds for the reception of such truths as may be discovered, without embittered discussions.

Patience, too, must be counselled. For much delay will ensue before this desired result is arrived at; patience under attack, patience under misrepresentation, but never controversy.

Thus will be hastened the time, when the glorious, all sufficient spiritual light, which though given through another race, we have adopted as our own, shall shine with its pristine purity, freed from the incrustations with which it has been obscured by the vanity of partial knowledge, and the temporary contrivances of human polity.

So, too, by freely extended scientific culture, may we hope that the infinitely thicker and grosser superstitions and corruptions will be removed, which greater age and more despostic governments have accumulated around the less brilliant, though important religions of our Asiatic Aryan relatives. These accretions being destroyed, the principal difficulty to the reception by those nations of higher spiritual truths will be obviated, and the intelligent Hindoo or Persian will not be tardy in recognizing in the pure life and elevated doctrine of the sincere Christian, an addition to, and fuller expression of religious precepts with which he is familiar. In this manner alone may be realized the hope of the philosopher, the dream of the poet, and the expectation of the theologian. A Universal Science, and a Universal Religion, coöperating harmoniously for the perfection of man and the glory of his Creator.

THE CROCODILE IN FLORIDA.

BY WM. T. HORNADAY.

In the warm, placid waters of tropical streams whose banks are bordered by reedy marshes and forests of perpetual green, is the home of the crocodile. About the middle of the day numbers may be seen lying lazily on the banks enjoying the heat, their polished scales shining in the sunlight, and all looking the very picture of tropical languor and repose. Its daily food is the

fishes that inhabit its native element, but many a bright-plumed water-fowl and unsuspecting quadruped falls a prey to its rapacity. Animals drinking at the stream's margin or swimming across are seized in the huge reptile's powerful jaws, dragged under water, drowned and devoured. The crocodile evinces a decided preference for tainted meat, and after capturing large prey it is often kept uneaten in the water until in a state of partial decomposition. The males are very pugnacious and often fight desperately for

Fig. 211.

Head of Florida Crocodile.

possession of the females. Sometimes an individual is captured whose tail is entirely gone, often the end is missing, sometimes a leg is wholly or partly wanting. Last winter we killed an alligator whose upper jaw was broken off squarely half way up to the eyes by some long previous accident.

The female crocodile lays from twenty to thirty eggs at a time. With her feet and nose she scoops a hole in the mud or sand on the shore, taking care to select a slightly elevated situation, and in this deposits her eggs in several layers, one upon another, placing a coat of earth, reeds and grass over each layer. The heat generated by the fermentation of this mass is sufficient to hatch the eggs in about thirty days.

While the crocodiles are distributed throughout all the southern hemisphere, in fact in all tropical regions, their cousins, the alligators, are confined to America; one species, the *A. Mississippensis* Gray, being especially abundant in the southern United States. It was formerly thought that the crocodile did not inhabit Australia, but it is now known to be there in respectable numbers, some specimens of great size having been captured. No one species of the *Crocodilidæ* is universally distributed, but the genus *Crocodilus* is widely known and has a greater range than any of its

congeners. The species are often confined to certain localities, and in a few their limits are very circumscribed.

The two American species of *Crocodilus*, viz., *rhombifer* and *acutus*, were first described by Cuvier as confined to the West Indies and South America, which view was accepted by naturalists for a long time. Subsequently the *C. acutus* has been discovered in different parts of Central America, and in 1870 Professor Jeffries Wyman described a skull from Florida as belonging to that species. Reports are current in Florida of a true crocodile existing there, but specimens have not been secured until very recently. The present year has thrown more light upon the subject by the capture of two fine specimens.

My personal observations on the subject were confined to the southeast coast of Florida, particularly the vicinity of Biscayne Bay. While there last winter collecting for the Museum of Prof. Ward, of Rochester, New York, I obtained sight of a reptile that I at first supposed to be a large alligator, but which a nearer view convinced me was a crocodile. After two unsuccessful attempts I succeeded in killing him by lying in wait for him with my rifle, opposite his favorite mud-wallow on the bank of the stream. It proved to be a male,—huge, old and ugly. His tenacity of life was surprising, and his frantic struggles in and out of water made the fight interesting for some time. He lived for quite an hour after six rifle-balls had been fired into his nape in the direction of the brain. He measured fourteen feet in length, and his girth at a point midway between fore and hind legs was five feet two inches. His teeth were large and blunt; his head rugose and knotty, with armor plates very large and rough, all conspiring to give him a very ugly and savage appearance. On dissection it was found that he had been very pugnacious, or else was a persecuted and unfortunate individual. Three of his teeth were more or less shattered; the tibia and fibula of the right hind leg had been broken in the middle and united, also one of the metatarsal bones of the same limb; about five inches had been bitten off the end of his tail leaving it quite blunt, and for some reason, probably an old wound, two of the vertebræ near the middle of the tail had grown together solidly at an awkward angle.

The day following the above capture (January 22, 1875) I had the further good fortune to kill at the same spot the mate of this crocodile, a beautiful female, measuring ten feet eight inches.

There was a striking contrast between the two specimens! The head of the female was regular in outline, comparatively smooth, teeth white, regular and sharp, plates even in surface and contour, and colors very marked. The entire under surface of both specimens was pale yellow, shading gradually darker up the sides with fine irregular streaks and spots of black. On the upper parts of the female through the entire length the black and yellow mottling was about uniform, the yellow rather predominating. The general appearance of the female was decidedly yellowish, while the back and tail of the male showed an almost entire absence of yellow, the prevailing color being a leaden, lustreless black. In brightness of color, smoothness of armor, and litheness of contour the female greatly outranked her rough and burly lord. The stomachs of both specimens were quite empty, but in the æsophagus of the male were the torn remains of two mud-hens in a state of disgusting decomposition. The ovary of the female contained four hundred and twenty eggs, varying from the size of No. 8 shot to a hen's egg, all perfectly spherical.

The exact locality of the captures was a narrow, very deep and crooked stream known as Arch Creek, flowing from the Everglades into the head of Biscayne Bay. While at Biscayne I collected abundant evidence that crocodiles, though rare, exist in various tributaries of the Bay. On the bank of Arch Creek, I found the skull, fifteen inches long, minus the lower jaw, of a crocodile belonging to the same species as the large specimens. No one could give me any information concerning it.

I succeeded in getting the perfect skull of a small specimen killed a few weeks before in Indian Creek, on the east side of the bay, quite near the seashore. Its length from occiput was seven and one-half inches. I was shown a small stuffed specimen fourteen and one-half inches in length, captured September 26, 1874, at the mouth of Miami River, ten miles farther down the bay. All the above specimens were taken in water that is brackish about half the time, being influenced by the tide. Prof. Ward has recently received a crocodile (skin and skeleton) from Lake Worth, Florida, ninety miles north of Biscayne Bay, which is of the same species as the foregoing. The skin measures nine feet ten inches.

In determining the species of these specimens I follow the late Dr. J. E. Gray, of the British Museum, as the best recent authority, his synopsis of recent crocodilians being the latest, most minute

and comprehensive. See Trans. Zool. Soc., 1867, vi, p. 125, *et seq*. Having been unable to examine the skull considered by Prof. Wyman it is impossible to give the differences between it and those in hand, but these latter certainly do not answer to any description of *C. acutus*, which at first I supposed them to be.

The following is Dr. Gray's description of *C. acutus*, and of the genus which he calls

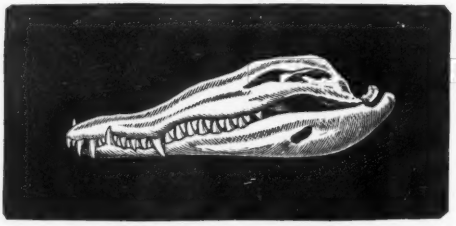
"MOLINIA.—Face elongate; forehead swollen, convex, especially in the adult; orbits without any anterior ridge. Nuchal plates two or four, small. Cervical disc rhombic, of six plates, side plates generally small. The legs fringed with a series of triangular, elongate scales. Toes webbed. Scales of the forearm and thigh thin, smooth."

"Muzzle oblong, elongate, slender, with a swollen convexity on the middle of the face before the eyes. Nostril not separated by a long ridge; the internal nostril posterior with an oblong sloping opening; intermaxillary suture produced behind between the ends of the maxillæ."

"M. AMERICANA.—Face slender, dorsal plates irregular; the central series small, keeled; lateral scattered, strongly keeled. Nasal bones produced to the nostrils."

It is necessary to give the characteristics of the genus since a very few points are sufficient to distinguish the species of *Molinia* of which there are only two. I shall now describe specimens of which there is a series of six, varying from fourteen and one-half

Fig. 212.



Skull of Florida Crocodile. Side view.

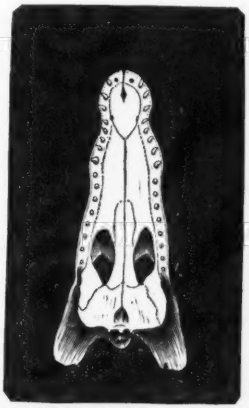
inches to fourteen feet in length. The description refers to the *adult* specimens, of which we have three.

Face elongate; forehead concave or flat; orbits without any anterior ridge. Nuchal plates four, small; three small keeled scales on each side of the neck between nuchal and cervical plates,

forming a row parallel to the row of nuchals, cervical disc rhombic, of six plates; legs fringed with a series of elongate scales. Toes of fore feet entirely free, the third and fourth hind toes partly united, and a very slight membrane between second and third. Scales of the forearm and thigh thick, and many convex or keeled. Dorsal plates in four longitudinal series; the vertebral series regular, large, average one-third broader than long, keeled; lateral series scattered, irregular hexagons, strongly keeled.

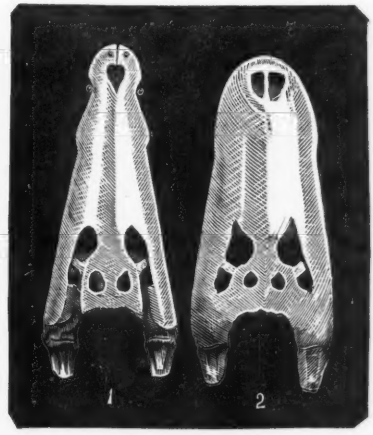
Muzzle elongate, broad in large specimens, with a high, swollen and prominent convexity on the middle of the face before the

Fig. 213.



Skull of Florida Crocodile. Under surface, showing outline of upper jaw.

Fig. 214. Fig. 215.



Upper surface of skull. 1, Florida Crocodile; 2, Alligator.

eyes. Nasal bones produced dividing the edges of the nostril; the intermaxillary suture produced behind between the ends of the maxillæ, the maxillary and intermaxillary bones pitted and tuberculated.

These specimens resemble the *C. acutus* and *C. rhombifer* Cuv. (*Molinia Americana* and *Palinia rhombifera* of Gray) in about an equal number of particulars, the main point of difference from the latter named species being the four rows of dorsal plates, of which the *rhombifer* has six. In fact these specimens seem to stand between the two species just mentioned, being equally related to each. The characters I have enumerated above seem distinctive,

and to indicate a new species for which I would propose the name *Crocodilus Floridanus*, or Florida Crocodile.

We present, for general illustration, a cut of the skull of an *Alligator Mississippensis* (Fig. 215) compared with the skull of a crocodile (Fig. 214). Both are from the same locality, Biscayne, Florida. The length of the alligator to which this skull belonged was nine feet ten inches, and that of the crocodile was ten feet eight inches, the figure being taken from the skull of the female here described.

I append the following measurements, in inches, of the three largest crocodile skulls. The first is that of the male 14 feet in length; the second that of the female 10 feet 8 inches in length; and the third, that of the Lake Worth specimen, 9 feet 10 inches in length.

Extreme length of head,	31½	21½	22
Length of skull from occiput,	24⅝	18	18
Greatest width behind,	14½	9¼	10
Width of forehead before,	5⅝	4	4
" " " behind,	7	4¼	4⅜
Breadth at notch,	4½	3	3
" " 10th tooth, following curve,	12⅝	7⅞	7⅞
" " 14th " " "	13	8	9
Number of teeth above,	18	18	19
" " " below,	15	15	15

REVIEWS AND BOOK NOTICES.

GEOGRAPHICAL VARIATION IN COLOR AMONG SQUIRRELS.—We have previously, in papers by Messrs. R. Ridgway and J. A. Allen, presented our readers with the latest views on the subject of the geographical variation in size, proportions and color among North American birds, and now reproduce in part a recent paper by Mr. J. A. Allen on the same subject, particularly variations in color as applied to the squirrels of America north of Mexico, published in the "Proceedings of the Boston Society of Natural History" (vol. xvi, Feb. 4, 1874). This is a subject to which local collectors can very largely contribute by the transmission of marked varieties or specimens possessing any peculiarities in size, proportions or color to the Museum of Comparative Zoology at Cambridge or to the Smithsonian Institution, where they can be studied to the best advantage, as large numbers of the commonest

species are indispensable in studying the variation of animals. Regarding color variations we quote the following remarks:

"First, in respect to the increase in intensity of color from the north southward. Among the squirrels this increase is finely illustrated in *Sciurus Hudsonius* and in *Tamias striatus*, representatives of which from the southern parts of New York and Pennsylvania are much more highly colored than are those from northern New England and the British Provinces. *Sciurus Carolinensis* is perhaps a still more marked example, in which the color varies from the light pure gray of the upper parts in New England specimens, with a restricted pale yellowish brown dorsal area, to the rusty gray dorsal surface of the Florida type, in which the whole upper surface is usually strongly yellowish-rusty. This increase of color southward is, however, still more strongly marked in the fox squirrels of the Mississippi Basin, the so-called *Sciurus "ludovicianus*."

* * * * * * *

"The variations in color occurring in representatives of the same species at localities differing in longitude, is well shown in quite a number of groups. But few specific forms, however, have a sufficiently wide range to illustrate the variations that obtain along a given parallel throughout the whole breadth of the continent, the *Sciurus Hudsonius* group being the only instance among the squirrels. Others, however, show the transition that obtains in passing from the moist, fertile prairies of the Mississippi Valley to the dry plains, or from the deserts and mountainous districts of the interior to the moist region bordering the Pacific coast north of the parallel of 40°. *Spermophilus tridecem-lineatus* furnishes a good illustration of the differences in color that occur between representatives of the same species living on the moist, fertile prairies and those inhabiting the dry, barren plains, those from Illinois, Wisconsin, Minnesota and Iowa being much darker than those from Western Nebraska, Western Kansas and Colorado. Even specimens from Eastern Kansas are much darker than those from the middle and western portions of the same State. In this species the color is varied, in passing from the prairies to the plains, not only by the lighter shade of the dark ground color, but by the considerably greater breadth of the light spots and stripes in the specimens from the plains."

* * * * * * *

"But two of the most instructive and interesting groups of the *Sciuridæ*, in this connection, are those of which the common *Sciurus Hudsonius*, and *Tamias quadrivittatus* are respectively familiar examples, the former ranging over the northern half of the continent, and the latter extending over the western half of North America and Eastern Asia. In the *Sciurus Hudsonius* group, we have at the east the well-known chickaree (*S. Hudsonius*), extending westward to the Plains, and northwestward to Alaska, with its

brighter and smaller southern form in the eastern Atlantic States. On the arid plains of the Platte and Upper Missouri rivers it presents a markedly paler or more fulvous phase, well illustrated by specimens from the Black Hills. This form becomes even still paler and more fulvous at the eastern base of the main chain of the Rocky Mountains, between latitude 43° and 47°, where it begins to pass by insensible stages of gradation into the so-called *Sciurus Richardsoni* of the Rocky Mountains north of 45°, and the so-called *Sciurus Fremonti* of the Rocky Mountains south of about the same parallel. In the collections made in Western Wyoming, near the Yellowstone Lake, occur many specimens which are so exactly intermediate between the three forms (*S. Hudsonius*, *S. Richardsoni* and *S. Fremonti*) whose habitats here meet, that it is impossible to say which of the three forms they most resemble. At the same time specimens can be selected which will form a series of minute gradations from the pale form of *Hudsonius* from the Plains, on the one hand, to the *Richardsoni* and *Fremonti* forms on the other. To the southward of this district we soon pass into the region of the typical *Fremonti*, and to the westward and northward into the habitat of the *Richardsoni* type. Even the country about the sources of the Gros Ventres Fork of the Snake River, is already within the range of the true *Richardsoni*. The habitat of *S. Richardsoni* extends from the main chain of the Rocky Mountains, north of latitude 44°, to the Cascade Range. Here it becomes mixed with *S. Douglassi*, which scarcely differs from *S. Richardsoni*, except in being a little darker above, and in having the ventral surface more or less strongly tinged with buff, varying in different specimens from cinereous to pure buff. This form prevails from the Cascade Range to the Pacific Coast, southward to Northern California, and northward probably to Sitka. In Northern California the *S. Douglassi* meets the range of the true *S. Fremonti*, between which two forms there is here the most gradual and intimate intergradation. In this group we have hence four forms which, in their extreme phases of mutual divergence, appear as diverse as four good, congeneric species need to, but which, at points where their respective habitats join, pass into each other as gradually as do the physical conditions of the localities at which their extreme phases are developed.

The *Tamias quadrivittatus* group[1] presents an equally or even more striking range of variation in color, and also varies to an unusual degree in size. Beginning at the northward, we find that specimens from as far south as Pembina, and thence northward, are quite undistinguishable from specimens from Northeastern Asia, or the so-called *Tamias* "*Pallasi*" (*T. Pallasi* Baird=*T. striatus* of most European authors). This form is found to only a limited extent south of the northern boundary of the United

[1] *Tamias quadrivittatus*, *T. Pallasi*, *T. Townsendi* and *T. dorsalis* of American authors.

States, where on the plains of the Upper Missouri it passes into the blanched, pallid form of *T. quadrivittatus* (*T. quadrivittatus* var. *pallidus* nobis,—see beyond), and farther westward into the true *T. quadrivittatus* of the Rocky Mountains, and still further westward into the so-called *T. Townsendi* of the Pacific Coast. In this group the greatest pallor is reached on the plains of the Yellowstone, and in the deserts of Nevada, Utah and Arizona. In the central portions of the Rocky Mountains (Colorado and portions of New Mexico) a form is developed distinguished by its generally bright, strong colors, but especially for the rich fulvous tints of the sides of the body, to which there is but a slight tendency either in the northern form or the pallid form of the plains. Both, however, very gradually pass into the rufous-sided type, the pallid form wherever the plains approach the mountains (as along the eastern base of the Rocky Mountains, the Uintah, Sierra Nevada, and others of the more southern ranges), gradually becoming fulvous, while the darker northern form grades into the larger fulvous race of the more northern portions of the Rocky Mountains in Montana and Idaho. This larger fulvous race west of the main divide soon begins to assume a duller, more fuscous shade, deepening finally into the very fuscous form (*T. Townsendi*) of the region between the Cascade Range and the Pacific Coast. In this form the general color increases so much in depth as to become dusky yellowish-brown, and both the light and the dark stripes become obscure, and occasionally almost entirely obsolete, through the gradual accession of color. Between the extreme phase of this fuscous type and the extreme phase of the pallid type of the plains, in which the stripes are sometimes again partially obsolete through the extreme lightness of the general color, the differences are very great indeed. Yet in placing the scores of specimens I have had the opportunity of examining in a geographical series, or arranging them simply according to their localities, a most thorough and minute intergradation becomes at once apparent. The difference in size, too, between northern and southern specimens is also unusually great; the pale, southern form of the plains, and the extremely bright, fulvous form of Colorado and New Mexico, being very much smaller than the northern, darker form, or than the fuscous type of the northwest coast.

As corroborative evidence that these varied types of coloration are but geographical races, it becomes interesting to observe that the light and dark and the fulvous and rufous forms respectively, of the different species, occur over the same areas. With the fuscous type of *Tamias quadrivittatus* occur the dark types of *Sciurus Hudsonius*, and the dark-backed form of *Spermophilus grammurus*, and also a peculiar, dusky form of Arctomys and of Lepus, and a dark form of *Spermophilus Richardsoni*. On the plains occur pallid forms of *Sciurus "ludovicanus," Sciurus Hudsonius*, *Tamias quadrivittatus*, and *Spermophilus Richardsoni*.

With the fulvous type of *Tamias quadrivittatus* occurs a rufous of *Spermophilus grammurus;* but the form of *Sciurus Hudsonius* occurring over the same area, presents the exceptional condition of a minimum amount of rufous."

Respecting the mammals and birds of the continent as a whole, Mr. Allen recognizes at least five more or less well marked areas characterized by certain peculiarities of color variation, and finds a striking correlation between these areas and the prevalent tendencies of color-increase and the amount of aqueous precipitation:

"The first region we propose now to define is that of the Atlantic Slope, which will include not only the country east of the Alleghanies, but a large part of the British Possessions, extending westward at least as far as Fort Simpson, and thence northward and westward to Alaska, including, apparently, all of that territory north of the Alaska Mountains, with an annual rainfall throughout the whole of this extended region of about thirty-five to forty-five inches. Over this region (to which we may give the general term of *Atlantic Region*) the colors may be regarded as of the average or normal type, those of other regions being either of a diminished or increased intensity.

The second region will embrace the Mississippi Valley, or more properly the Mississippi Basin, and may hence be termed the *Mississippi Region.* Here the annual rainfall reaches forty-five to fifty-five inches, and over a small area east of the Lower Mississippi even exceeds sixty inches. The tendency here is so often to an increase of fulvous and rufous tints, that we may regard this as the distinctive chromatic peculiarity of the region, these tints reaching their maximum in the limited area of greatest humidity, but a general increase in intensity of color is also more or less characteristic of the region. A third region embraces the central portion of the Rocky Mountains, and being developed most strongly within the present territory of Colorado, and being also mainly included within that territory, may be termed the *Colorado Region.* The tendency here again, as compared with the immediately adjoining districts, is to a general increase of intensity of color, with also a marked inclination to the development of rufous and fulvous tints, this region being also within the influence of a comparatively high temperature, at least in summer. The humidity is here less than in either of the other regions already defined, the annual aqueous precipitation amounting to only about twenty-four to thirty inches; but it is yet greatly in excess of that of the districts immediately surrounding it.

The fourth region may be regarded as made up of the arid plains and deserts of the great central plateau of the Continent, including not only the "Great Plains," usually so called, but the

deserts and plains of Utah, Nevada, Western Colorado, New Mexico, Arizona and southwestward to Lower California, and may hence be appropriately termed the *Campestrian Region*. The annual rainfall is generally below fifteen inches, but ranges, at different localities, from three inches to twenty. Here a general paleness of color is the distinctive feature. The fifth region begins on the Pacific Coast at about the 40th parallel, embracing a comparatively narrow belt along the coast from Northern California to Sitka. Its peculiarities are most strongly developed west of the Cascade Range, north of 45°; they also prevail eastward nearly or quite to the main chain of the Rocky Mountains. It may hence be termed the *Columbian Region*. With an average annual rainfall of fifty-five to sixty-five inches, the prevalent tendency in color is to dusky and fuscous rather than rufous tints. The district between the Cascade Range and the main chain of the Rocky Mountains presents features that may almost entitle it to rank as a distinct region, as might also the region of maximum rainfall in the Mississippi Region. The southern half of Florida is also perhaps entitled to recognition as a distinct region, being characterized by excessive humidity and a subtropical intensity of color. It may also be necessary eventually to recognize as distinct districts the almost rainless portions of the Campestrian Region."

* * * * * * *

After looking at the subject in this broad way the reader need not feel surprised at the suppression of a good many nominal species. In 1857 Professor Baird reduced the number of species of Sciurus from twenty-four to ten, with two doubtful ones; Mr. Allen now reduces them to *five*, with seven geographical varieties in addition. The number of North American species of Sciuridæ in all is twenty-five.

BOTANY.

The Starch of Zamia. — The roots of *Zamia pumila* yield a large per cent. of starch. The plant grows abundantly at the head of Biscayne Bay, Florida. I also found it, though not abundantly, at New Smyrna and Cedar Keys, Florida. The soil at the head of Biscayne Bay is full of loose pieces of limy rocks; between the interstices of these the plant grows; this kind of soil suits it best. The leaves have the general appearance of ferns; its roots are rough, of a gray color, and of the shape and size of parsnips. Not only is it abundantly reproduced from seed, but any piece left in the ground grows. It could be cultivated and made profitable.

The root yields two kinds of starch, white and yellow; also a poisonous substance. The white starch is very nutritious and makes excellent puddings, much nicer than sea moss, farina or corn starch; in fact, it is equal to any starch for domestic or manufacturing purposes. The yellow starch is much lighter than the white, and can be easily separated.

The roots yield a larger per cent. of white starch during the dry season, when the plant is at rest; when growing it produces more yellow starch. If used at this period a good slice is taken off the top and bottom, containing mostly yellow starch, which is feed to chickens and hogs. They, however, never get fat, as the substance contains but little nourishment. If the root is used in the dry or resting season, the very tip of the root is taken off, and a very thin slice with the leaves.

After the roots are washed clean and deprived of the necessary slice from top and bottom, they are then ground into a pulp, mixed with water and which is passed through a screen. This process carries off the poisonous matter as it is run off. The yellow, being so light and not adhesive to the white starch, is easily taken off. Both kinds dry easily in the sun. If the water and starch remain together long, fermentation takes place, and the two grades of starch will not separate. It is therefore best to grind the roots quickly, draw off the water and separate the starches promptly, as a pure white article is required for commerce.

The Seminole Indians make but little starch for sale; they have not the facilities for separating and drying; but they make a good deal for their own use, as they are not particular about leaving the less nutritious yellow with the white. The Indians make it into mush, either separate or mixed with flour; they also make bread of it, using the starch mixed with corn meal or flour. There are several mills among the white settlers of Biscayne Bay for the manufacture of this starch.

The seed of this plant is covered with a bright orange pulp, which, if eaten, has a dangerous narcotic effect. The leaves of the Zamia are the favorite food of that beautiful butterfly *Eumœus Atala*, which surpasses in beauty all other butterflies of Biscayne Bay; it is more numerous than any other; it is not exaggeration to say that it equals in number all the other species of butterflies in that region. They fly low, with a slow, measured motion,

alighting rather suddenly upon the leaves, are taken easily, as they are not shy nor easily disturbed. This plant is very common in the pine woods; often in botanizing I have seen but few other plants, consequently the Atala would be very numerous. Often three or four occur on one plant. Their eggs, well-matured pupæ, cocoons and caterpillars, are found upon the same plant.

This plant is commonly called Compte, and the starch goes by that name, while the Atala butterfly is called "Compte Moth." The inhabitants readily recognize the caterpillars, as they and their parent are unlike any other of the butterflies of Biscayne Bay. Several chrysalides were placed in a box, part of them had nearly completed their transformation, others were not so advanced. The first hatched in five days, the others in seven days. Whether they would have hatched in that time if left upon the plant is more than I can tell. I noticed this insect feeding upon the banana leaves in the gardens, but upon no other plant did it seem to feed, other than its natural one, the *Zamia pumila*. — E. PALMER.

ZOOLOGY.

ON AN UNDESCRIBED ORGAN IN LIMULUS, SUPPOSED TO BE RENAL IN ITS NATURE.[1]—In dissecting the king crab one's attention is directed to a large and apparently important gland, conspicuous from its bright red color contrasting with the dark masses of the liver and the yellowish ovary or greenish testes, and presenting the same appearance in either sex. The glands are bilaterally symmetrical, one situated on each side of the stomach and beginning of the intestine, and each entirely separate from its fellow. One of these glands consists of a stolon-like mass, running along close to the great collective vein, and attached to it by irregular bands of connective tissue, which also holds the gland in place. From this horizontal mass, four vertical branches arise, and lie between and next to the partitions at the base of the legs, dividing the sides of the body into compartments. The posterior of these four vertical lobes accompanies the middle hepatic vein from its origin from the great collective vein, and is sent off opposite the insertion of the fifth pair of feet. Half-way between the ori-

[1] Read at the Philadelphia Meeting of the National Academy of Sciences, held in Nov., 1874.

gin of the vein and the articulation of the foot to the body, it turns at a right angle, the ends of the two other lobes passing a little beyond it, and ends in a blind sac, less vertical than the others, slightly ascending at the end, which lies just above the insertion of the second pair of feet. The two middle lobes are directed to the collective vein. Each lobe is flattened out somewhat and lies close to the posterior wall of the compartment in which it is situated, as if wedged in between the wall, and the muscles between it and the anterior portion of the compartment. Each lobe also accompanies the bases of the first four tegumentary nerves. I could not by injection of the gland, make out any general opening[1] into the cavity of the body or any connection with the hepatic or great collective vein; any attempts to inject the gland from the veins failing. The four lobes certainly end in blind sacs. The lobes are irregular in form, appearing as if twisted and knotted, and with sheets and bands of connective tissue forming the sheaths of the muscles among which the gland lies. Each lobe, when cut across, is oval, with a yellowish interior and a small central cavity, forming, evidently, an excretory duct. The gland externally is of a bright brick red. The glandular mass is quite dense, though yielding. It is singular that this conspicuous gland, though it must have engaged their attention, has not been noticed by Van der Hoeven, Owen or A. Milne-Edwards in their accounts of dissections of this animal.

When examined under a Hartnack's No. 9 immersion lens and Zentmayer's B eye piece, the reddish external cortical portion consists of closely aggregated irregularly rounded nucleated cells of quite unequal size, and scattered about in the interstices between the cells are dark reddish masses which give color to the gland. They are very irregular in size and form, and twenty hours after a portion of the parenchyma was submitted to microscopic examination vibrated to and fro. I am reminded in the vibrating movements of these bodies, of Siebold's (Anatomy of the Invertebrates) description of similar bodies in the renal organs of the Lamellibranchs, *i.e.*, the gland of Bojanus. He says in a foot-note, p. 214 (Burnett's Translation), "If the walls of these organs are prepared in any way for microscopic examin-

[1] Leydig (Naturgeschichte der Daphniden) states that several anatomists, after laborious attempts, have failed to find the opening to the green gland in any crustacean.

ation, a part of their parenchyma separates into a vesiculo-granular mass, the particles of which have a very lively dancing motion. The motions are due to portions of ciliated epithelium adhering to the cells and granules."

In other portions of the outer reddish part of the gland, where the pigment (?) masses are wanting, the mass is made up of fine granular cells, not nucleated. Other cells have a large nucleus filled with granules and containing nucleoli.

In the yellowish, or, as we may for convenience call it, the medullary portion, are scattered about very sparingly what are probably the round secreting cells. The nucleus is very large and amber colored, with a clear nucleolus; others have no nucleolus, and the small ones are colorless.

I am at a loss to think what this gland with its active secreting cells, filled with a yellowish fluid, can be, unless it is renal in its nature. This view is borne out by the fact of its relation with the hepatic and great collective vein. If future examination shows some outlet into the venous circulation, then its renal nature would seem most probable. No other organ that can be renal in its nature exists in Limulus. In its general position and relations it is probably homologous with the green gland of the Decapod Crustacea, and its homologue in the lower orders of Crustacea, which is supposed also to be renal in its nature. It may also possibly represent the organ of Bojanus in the Mollusca, which is said to be renal in its function. It perhaps represents the glandular portion of the segmental organs in worms. That so large and important a gland is an embryonic gland, in adult life aborted and disused, is not probable, nor is there any good reason for regarding it as analogous to the suprarenal capsule of the vertebrates, analogues of which are said by Leydig to exist in Paludina and Pontobdella.

Reasoning from their histological structure, and by exclusion, it seems not improbable that these glands are renal in their nature and homologous with the green glands of the normal Crustacea.

They seem also homologous with the organs described by M. A. Giard in the Rhizocephala, and said by him to be "situated on each side of the middle part of the animal, and generally colored yellow or red (primitive kidneys?)." Annals and Mag. N. H., Nov., 1874, p. 383.

I may add that all these observations were made on living Lim-

ulus Polyphemus, in the laboratory of the Anderson School of Natural History at Penikese Island, Mass.—A. S. PACKARD, Jr.

BIRDS BREEDING ON PENIKESE ISLAND.—The following birds have been observed by me, breeding upon the island during the summer months of July and August, 1873, and '74.

Hirundo horreorum Wils. Barn swallow. Several nests have been found in the barn and beneath several old sheds, and may be called common.

Petrochelidon lunifrons Cab. Cliff swallow. One nest found on the outside of an old shed. Rare.

Cotyle riparia Boie. Bank swallow. A small colony on the northwest side of the Island in a small sand bank. Common or not rare.

Passerculus Savanna Bon. Savanna sparrow. Found breeding on the ground all over the Island. Common.

Pooecetes gramineus Bd. Grass finch, bay-winged bunting. Several nests have been taken. Not common but may be found more abundantly.

Melospiza melodia Bd. Song sparrow. Several nests have been found. Not rare.

Agelaeus pheniceus Vieill. Red-winged blackbird. Nests in the sedge grass, not very abundant, on the north shore of the larger Island. Not rare.

Sturnella magna Vieill. Meadow lark. Breeds in the fields of the larger Island in several places. Common.

Tyrannus Carolinensis Cuv. Kingbird, bee martin. One nest of four eggs was found by me in the bow of an old sail boat on the north side of the island in 1873; have seen none since.

Tringoides macularius Bon. Spotted sandpiper. A few pairs have been found breeding along the shores and in the grass near the shore. Common or not rare.

[*Tachycineta bicolor* was found breeding on the island in the summer of 1873, by Mr. A. S. Scott, as we are informed by Mr. C. O. Whitman.—EDS.]

Sterna hirundo Wils. Wilson's tern. Breeds abundantly all along the shores and in the grass near the shores.

Sterna paradisea Law. Roseate tern. Breeds with the former, but perhaps not quite so abundantly, but both breed by hundreds, though they are fast leaving for more secure quarters.

Sterna supercilliaris Vieill. Least tern. I add this on the authority of Mr. C. O. Whitman by whom a young bird was found, probably bred here in former years.[1]

Other forms may possibly be found, though owing to the smallness of the island I rather doubt it. — W. STEARNS.

PRAIRIE MICE. — Last fall, some boys out hunting, for lack of larger game, chased some prairie mice into an old stump. With the aid of the dog the stump was quickly demolished, exposing the winter quarters of some eight or ten mice. Two of the little fellows were captured alive; tied into a mitten and brought to me. They were placed in a tin box; in the evening the box was set on the table and the cover removed. The mice soon became so tame that they would leave their box, play over the table and take morsels of food from our hands; but they would never allow us to catch them. In fact that seemed an impossibility, although often attempted; our hands would invariably be found empty and the mice sitting on the opposite side of the table coolly washing their hands, seeming to enjoy our discomfiture. These mice had eyes and ears much larger than those of the house mouse; the hair on the throat, abdomen and feet, pure white. Their motions were all exceedingly quick, they never walked but darted or jumped from one position to another. When performing their ablutions their comical appearance invariably excited laughter; one little paw would be moistened and drawn over the ears and face, so rapidly that it required sharp eyes to follow the motion, the other paw alternating till a satisfactory state of cleanliness was obtained. As a final touch to the toilet, the long, slender tail, was switched through the mouth from base to tip with lightning speed.

I observed one habit in our mice that I do not remember to have seen noticed before in any of the Muridæ. When frightened they would make a clear, quick, rattling noise, by alternately lifting their fore feet and vibrating them against whatever they were resting on. Occasionally a loosely folded paper was laid on the table for the mice to hide in; they sprung their rattle much more frequently when on the paper than when hiding behind books on the table; probably because they found the paper a better medium of sound than the solid table with its cloth cover. In a

[1] There were some twenty pair of this bird there last summer breeding.—T. M. B.

hollow log or stump, this noise probably proves an effectual means of communicating alarm to each other. After keeping our pets about three months they escaped from us; we never knew how or where; the lid was pushed from the box and they were gone.—J. M. MILLIGAN.

BEARS, ETC., IN ARIZONA.—In Dr. Coues' article on "The Quadrupeds of Arizona" (AM. NATURALIST, vol. 1, No. 7, p. 354), I find but two species of the Ursidæ mentioned as residents, and one *variety*, *U. horriæus*, as extending into Mexico. While attached to Lt. Wheeler's Expedition as Naturalist in 1871, I saw large numbers of bear skins amongst the Coyoté Apachés, then living at Camp Apaché in Eastern Arizona.

Black skins appeared most abundant, next grizzly, and occasionally that of the cinnamon bear. The latter hides were in such bad condition that I declined trading for them, although half a pound of "Army plug" would have secured one.

The Indians, as well as the officers at the Post, informed me that bears were abundant in the Mogollon Mts., but the former seldom attack a grizzly. Dr. Soulè, Post Surgeon, said, that while taking a horse-back ride up the wooded banks of the Rio del Sal one day, he suddenly came upon four large grizzly bears, and as they did not show any disposition to leave, he suddenly retraced his tracks to the Post. One large bear, of the same species also, upon another occasion had the curiosity to cross the ravine and go about the parade ground, until fired at by the sentinels, when he trotted off, threw himself over the precipice (on the river side of the post) into the water, swam across and disappeared amongst the pines.

At Bill Williams Mt., we shot one grizzly, and found numerous tracks around the springs. Wild Turkeys were occasionally seen, and as we approached Postal's Ranche, about twenty miles north of Ft. Whipple, we saw and chased several herds of Antelope. While in the mountains we also obtained five specimens of *Cervus macrotis* Say, which appeared rather abundant. There is another mammal, the beaver (*Castor Canadensis* Kuhl.), quite abundant near Camp Verde. Five miles northeast of the Post, Beaver creek contains numerous dams, and colonies of these animals and many pelts are annually collected, though a few years will suffice to exterminate a race, covering so small an area, and hemmed in by waterless deserts and rocky cañons.—W. HOFFMAN, M.D.

ALBINO FISHES. — Two interesting cases of albinism in fishes have recently fallen within my observation. The first was a specimen of the common haddock (*Melanogrammus æglefinus*), taken off Barnegat, N. J., May 7th, by the schooner "White Cloud," of New London, and shown to me by my friend, Mr. Blackford, of Fulton Market, New York. This fish, which was thirty-one inches long, was normal in every particular except in color. Its general hue was pinkish-white, with a pearly lustre, instead of the usual brownish-gray. The back and top of the head were slightly darker, approximating a very light salmon color. The black stripe which usually marks the lateral line and the blackish-brown blotch, behind and above the pectorals — the traditional mark of the thumb of the disciple Peter — were entirely absent. The fins throughout were yellowish white with a tinge of red, except the ventrals which were a shade darker. The slightest trace of the normal ashy tint of the belly might be discovered just below the origin of the pectorals.

The second instance is a specimen of the common eel (*Anguilla Bostoniensis*) taken in salt water at Noank, Conn., in December, 1874, and presented to the U. S. National Museum, by Capt. Elihu Potter. In this the color is a dull, pale yellow above, becoming nearly white beneath.

According to M. Dareste albinism is not uncommon among European eels. It appears, however, to be very exceptional in our waters. I have never seen or heard of an instance besides the case just cited. True albinism is especially uncommon among the members of the family to which the haddock belongs. The ground color of the cod and haddock varies much with the bottom on which they are taken, but I have never known of a case in which the spots and other markings were obliterated. A familiar instance of the influence of the color of the bottom is found in the rosy "rock-cod" of the coast of Maine, which is usually taken in the neighborhood of ledges covered with the bright red algæ such as *Ptilota serrata* and *Delesseria sinuosa*. In a similar manner the "butter-fish" (*Enneacentrus ouatalibi*) and the "grouper" (*Epinephelus fasciatus*) are influenced by the white coral-sand bottoms about the Bermuda Islands, but though they assume a very pallid hue, the character of their markings is quite unchanged. — G. BROWN GOODE, *University Museum, Middletown, Conn.*

[In the Fish collection of the Peabody Academy of Science there are examples of both of the above mentioned albinos. The haddock, agreeing with the description given by Prof. Goode, was taken off Newburyport some years ago, and sent to the Museum by Mr. Johnson of that place. The "white" eel was collected under the following peculiar circumstances: During the severe gale of Nov. 7, 1865, in Mass. Bay, a small *Cyclopterus* (lump fish) and the eel were washed aboard the schooner "Hero," Capt. Small, who found them on his deck after the gale and brought them to the Museum on his arrival at Salem the next day.—F. W. P.]

Chloral as a Preservative.—As it is very desirable that a substitute for alcohol be found for the purpose of preserving specimens, we copy the following from the New York "Tribune," trusting that trials of the experiment will be reported.

The "Philadelphia American Times" contains an article by Dr. W. W. Keen upon the anatomical, pathological, and surgical uses of chloral, in which he recommends this substance very strongly for the preservation of objects of comparative anatomy and natural history. It is used by injection into the blood vessels, or by immersion, and in his opinion it is likely to supersede many of the preparations now in use. Its special advantage is that the color of the object is preserved perfectly, and all the parts have a natural consistency, while there is nothing either poisonous or corrosive to affect the general health of the experimenter or to injure instruments.

For preserving a subject for dissection, half a lb. of chloral will suffice at a cost of a dollar or less. A solution for preserving specimens of natural history of ten or twelve grains to the ounce of water is quite sufficient, is much cheaper than alcohol, and the bottles instead of being hermetically sealed are closed by glass stoppers, or even ordinary corks. Dr. Keen has thus kept pus from various substances, and diseased growths of various kinds of other specimens for months, and found no change whatever in their character. Chloral is extremely antagonistic to fungi and infusoria, a very weak solution of it killing them instantly.

The deodorizing as well as the antiseptic properties of chloral are equal in Dr. Keen's opinion to those of any substance now known.

EXTRAORDINARY ALTERNATION OF GENERATIONS. — *Leptodera appendiculata* lives in *Arion ater* as larva (mouth and vent closed; tail with two long cuticular bands). If the snail is laid in water, or stimulated forcibly to muscular contractions, these small nematoids are expelled in great numbers, and rapidly develop in the water or any slimy substance; the bands are lost, mouth, genital orifice and vent become opened through the casting off of the entire cuticle, generative elements are developed and copulation takes place. The rapidly developing embryos do not attain the size of the parasitic generation, want the bands, and are in other respects unlike, but adopt the characters of the genus Rhabditis. They do not need any change of condition for attaining sexual maturity; they copulate, produce a third generation, etc. In this manner an indefinite series of generations may follow, until the nutritive substance is exhausted, when encystation takes place. The migration into the snail and the presumed transformation into the *Leptodera*-form of these encysted *Rhabditis* worms, was not observed. Between male and female individuals of the *Leptodera*- and *Rhabditis*-generation, no copulation will take place. There is some analogy (in spite of the great difference) between this extraordinary "alternation of generations" and that of *Ascaris nigrivenosa* Claus. — *Zoological Record for* 1872.

A TACHINA PARASITE OF THE SQUASH BUG. — It appears that the squash bug (*Coreus tristis*) is frequently infested by a maggot, the larva of a Tachina fly, as numerous specimens have been taken from the bodies of the males by Mr. Knollen, to whom we are indebted for specimens. The larvæ are very large, one specimen only occurring in the body of the Coreus, which seems apparently healthy, and performs its sexual functions in spite of the presence of so large a parasite. They are seldom found in the Hemiptera, though Pentatoma has been attacked by them.

DOUBLE MONSTERS. — M. Dareste, in reply to the discussion which his paper on double or twin monsters (as given in a former number) had called forth, explains the nature of the observations on which his deductions were based. It would appear that after submitting nearly 8,000 hens' eggs to the process of artificial incubation, he obtained nearly 4,000 anomalies or monstrosities, but of these only about thirty were double embryos or twin monstrosities. A similar result has been observed in the case of osseous

fishes; and Jacobi, who was the first to discover (in the course of the last century) the mechanism of fecundation among these fishes, had noted the proportion of twin monsters in fishes' eggs. His observations and those of Lereboullet coincide with the result obtained by M. Dareste, that while external conditions may often determine the formation of simple monsters, they are absolutely without effect in regard to the evolutions of double monstrosities. —*Nature.*

Importation of useful Insects.—At a recent meeting of the London Entomological Society, Mr. Dunning stated that he had received a communication from Mr. Nottidge, of New Zealand, asking if it were possible to send over humble-bees, in order, by means of cross fertilization, to procure seeds from clover, which plant remained infertile in the colony, failing suitable insect agency to aid its fertilization. It was suggested that by procuring a sufficient number of humble-bees when in a dormant condition, and keeping them in that state (by means of ice) during the voyage, the result might be obtained. Mr. McLachlan mentioned that he had received a letter from Capt. Hutton, from the same colony, stating that indigenous *Aphides* did not, apparently, exist there, but imported species were becoming very destructive, and he asked if it would be possible to import *Chrysopa.*—*Entomologist's Monthly Magazine, Jan.*, 1874.

Nesting of the Prairie Warbler in New Hampshire.—I obtained in northern New Hampshire, at the latitude of Mt. Washington ($44\frac{1}{2}°$), a nest of the prairie warbler, containing four eggs, which differ from all other specimens that I have ever seen. It is also a summer resident there, though Lynn, Mass., in $42\frac{1}{2}°$ latitude, has hitherto been generally accepted as the northern limit at which this bird breeds.—H. D. Minot.

GEOLOGY.

Elden Hole, Derbyshire.—We copy the following abstract from "Nature" of a paper read by Mr. R. Pennington before the Literary and Philosophical Society of Manchester, Jan. 26, as of interest in its bearing upon the formation of similar so-called bottomless pits in this country.

"Near the road from Buxton to Castleton, and about four miles from the latter place, stands Elden Hill, in the side of which is

Elden Hole, a perpendicular chasm in the rock, and, like many such apertures, reputed to be bottomless. The author describes a descent into the cavern, made by himself and others, on the 11th of September, 1873. At a distance of 180 feet from the top a landing-place was reached, although not a very secure one, as it was inclined at an angle of about 45°. Thence a cavern ran downwards towards the south or southeast; the floor was entirely covered with loose fragments of limestone, probably extending to a considerable thickness. There was quite sufficient light at this point to enable one to sketch or read. The party then scrambled, or rather slipped, into the cavern for some few yards, during which they descended a considerable distance: it was of a tunnel-like shape; then it suddenly expanded into a magnificent hall about one hundred feet across and about seventy feet high. The floor of this hall sloped like the tunnel, and like it was covered with *débris*. At the lower side they were about sixty feet below their landing-place, and therefore about two hundred and forty feet beneath the surface. The entire roof and walls of this cavern were covered with splendid stalagmitic deposits. From the roof were hung fine stalactites, whilst the sides were covered with almost every conceivable form of deposited carbonate of lime. In some places it was smooth and white as marble, in other places like frosted silver, whilst the rougher portions of the rock were clothed with all sorts of fantastic shapes glistening with moisture. From this cavern no opening of any length or depth was found save the one by which the party had entered it. There can be no doubt, the author believes, that this chasm has been formed by the chemical action of carbonic acid in water, and that it has attacked this particular spot either from the unusual softness of the rock originally situated here, or because there was here a joint or shrinkage in the strata. There is nothing, however, in the position of Elden Hole to lead one to suppose that any stream has ever flowed through it; no signs of such a state of things appear anywhere around. It is not related to any valley or ravine, or to any running water, and there is, as observed, an absence of any well-defined exit for water at the bottom. No mechanical action of a flowing stream can therefore have assisted the process of enlargement. The author thinks it must be due to the gradual silent solvent properties of rain-water falling on the surface, and escaping through jointings and insignificant channels in the hard rocks below. Whether the excavation took place from above or below is uncertain."

MICROSCOPY.

Atmospheric Micrography.—To the already valuable contributions of Drs. Cunningham and Lewis, who were sent to India by the British government to investigate as thoroughly as possible the causes of cholera and other diseases prevalent there, there

is now added, from Calcutta, a memoir by Dr. Cunningham on "Microscopic Examinations of Air," which derives importance not less from the moderate and unprejudiced tone of the author than from his evident familiarity with the minute organisms involved in the investigations. In looking for some perceptible connection between the prevalence of certain forms of disease and the occurrence of any particular bodies in the air, the dust accumulated on shelves, etc., was avoided as too liable to error, and the solid particles were collected directly from the air by a modification of Dr. Maddox' apparatus, a glass slip painted with glycerine being arranged five feet above the ground in such a manner that the painted surface should be exposed vertically to a stream of air. Some sixty observations were made between February and September, 1872, including both dry and rainy seasons; and powers of from 400 to 1,000 were generally used. The following synopsis of microscopic deposits found is condensed from Rev. M. J. Berkley's review in the Quart. Jour. Mic. Science.

1. Particles of silicious matter.
2. Particles of carbonaceous matter.
3. Fragments of hair and other animal substances.
4. Fragments of cellular tissue of plants.
5. Pollen grains; of several common grasses, and a few of other plants. No seeds positively recognized.
6. Algæ, few; but besides "those lower genera which appear to be the early stages of lichens" (!) there were fragments of Oscillatoriæ, Desmidiaceæ, Closterium, and possibly Diatomaceæ.
7. Sporidia of lichens; frequent.
8. Spores or sporidia of fungi. These are by far the most abundant bodies; which is more remarkable by contrast with Ehrenberg's observations on the dust of the trade winds. Many of the fungoid organisms are easily referred to familiar genera, Macrosporium, Cladosporium, Sporidesmium, Puccinia, etc. Much the most common are sporidia of Spheriaceæ frequently in a state of germination, both in dry and hot seasons. True Torulæ do not appear to be present, but the yeast fungus, which after proof that it is nothing more than a condition of certain species of Penicillium, Aspergillus, and Mucor, is so often referred to Torula, or to Algæ, frequently occurs, either in scattered particles, or branched. Probably several of the bodies are spores of Myxogastræ, the Amæbæ which appear in certain specimens of pure rain water being

very probably the mere development of *Myxogastres*-spores, according to the well known observations of Prof. DeBary. Some spores of the higher fungi may possibly be recognized.

The air of sewers was repeatedly examined, taking care to exclude the external air (a probable source of error in some previous investigations), and only spores of Aspergillus and Penicillium were definitely recognized, these in half the cases being accompanied by Bacteria. The abundance of Bacteria, which are seldom recognizable in common atmospheric dust, accords with Cohn's observation on their conveyance by watery vapor, and suggests the theory that they are not absent or rare in common atmospheric air, but only so dry as to lose their characteristic appearance. They were present in pure rain water; and appeared abundantly when dry dust was added to fluids capable of putrefaction.

The author was able to trace no connection "between the numbers of bacteria, spores, etc., present in the air and the occurrence of diarrhœa, dysentery, cholera, ague, or dengue, nor between the presence or abundance of any special form or forms of cells and the prevalence of any of these diseases. The abundance and variety of fungus-spores in such an unexpected position are interesting, especially as so many of them were in a state of germination. As they would rarely be taken up by the air in this condition, and any possible germination on the slide during its twenty-four hours' exposure would not account for all the cases, Dr. Cunningham is inclined to believe that germination may take place while the spores are being wafted through the air.

Respecting the presence of pollen in the air, the editor of the "Quart. Journal of Microscopical Science" gives the following note on Mr. C. H. Blackley's interesting studies on the connection between the pollen grains of grasses and hay-asthma. "They were commenced in April, and continued till the end of July. In one series the air of a meadow at the average breathing level, 4 feet 9 inches from the ground, was examined. A slip of glass, coated with a thin layer of a non-drying liquid, was exposed horizontally. The daily results are tabulated. The highest number of pollen grains obtained on a surface of a square centimeter in twenty-four hours was 880 on June 28. Sudden diminutions in the quantity of pollen, when these occurred in the ascending scale between May 28 and June 28, were invariably due to a fall of rain, or to this and a fall in the temperature combined. The amount of pollen

in the higher strata of the atmosphere was examined by means of a kite, which being attached to other kites sometimes attained an elevation of 1000 feet. Pollen was found to be much more largely present at the upper levels than at the 'breathing level,' in the proportion, in fact, of 19 to 1. Abundant proof was obtained of the presence of fungoid spores in large quantities in the air. In one experiment the spores of a cryptogam, at 1,000 feet, were so numerous that they could not be counted; at a rough estimate they could not be less than 30–40,000 to the square inch. That these organized contents travel through the air to a considerable distance was proved by a series of experiments made in the outskirts of Manchester, but within the boundary of one of the most densely populated parts, and in no direction within less than one-third of a mile of grass land. The quantity of pollen was about one-tenth of that collected in the country."

NOTES.

The American Association for the Advancement of Science.—The twenty-fourth meeting of the Association was held in Detroit, Mich., beginning on Wednesday, August 11, and ending on Tuesday night following. In attendance, the meeting was not as large as the one preceding, about 170 members reporting themselves as present, in place of 225 the previous year; 96 new members were elected, while last year 118 elections were made. The falling off in attendance is unquestionably due to the want of arrangements with the railroads, by which the usual reduction in fares was not very generally secured, and to the late day at which the announcement relating to railroads was made. Perhaps in no previous year has the necessity for reduction in travelling expenses, caused by the general business depression, been so greatly felt as in the present one. As the cities inviting the Association to hold its meetings from year to year, do so in a most cordial manner, with the anticipation of large meetings, it becomes an important duty of the Local Committees that are formed every year to give the matter of transportation early attention. Railroad companies carry on their work by a complicated system of agencies, and it takes a long time to obtain the consent and issue of proper orders from the right parties. The companies, as a rule, are inclined to grant return passes to members attending the meetings, when the matter is properly laid before them, and

the way of attaining the desired end is by application of the Local Committee several months in advance of the meeting, so early in fact, as to allow the circular issued by the Committee being received by members during the month of June, before the general migration from places of residence takes place.

Of the 136 papers entered, 2 were read in General Session in full, and 2 by title, 1 was given as an evening lecture, 24 were read in Section A; 19 in the Sub-section of Chemistry; and 71 were read in Section B, including those of the Sub-section of Geology, formed on the last day of the meeting. Of the remaining 17 nothing was heard, and they were probably withdrawn by their authors or failed to pass the Several Committees.

The general character of the papers read was certainly above the average of many previous meetings, and the various Committees were well up to their work. The only drawback we noticed, being that of the formation of a Geological Sub-section on the last day, which resulted in a number of important papers being hastily read, or passed over by title, before a small audience. We think a great mistake is made by the Sections not agreeing on what Sub-sections are necessary on the first day, though not necessarily forming them until later in the meeting, and thus enable the Committees to so arrange the business as to give all the papers a fair chance. This could easily be done if members would make it a rule to enter their papers not later than the first day of the meeting. We understand that the feeling in the Standing Committee was very strong in favor of giving precedence, at future meetings, to those papers entered up to the first day, and as the Committee is now composed of so large a permanent body, the lessons taught at one meeting will not be lost at the following. An important move was made in forming a permanent Sub-section of Anthropology, on the principal of that of Chemistry in Section A. This will greatly relieve the pressure for time next year in Section B, and will undoubtedly be the means of bringing a very large number of Archæologists and Ethnologists to the next meeting.

The new constitution was thoroughly tested at the meeting and the business matters went on smoothly and saved much time for scientific work. We did not hear a word of complaint among the members in regard to the action of the present rules, and every one was evidently satisfied that under them the Association would move along with the least possible amount of friction. Several

of the past presidents were present, and their advice in the Standing Committee was evidently of great benefit. As alluded to in the closing remarks by President Hilgard, the several summer schools, and government and state surveying expeditions and special commissions, which are unusually numerous this year, prevented a number of the formerly constant attendants from taking part in the meeting, but as their work in the field shows what is being done to advance science, and as the results which they attain will, in part, naturally be brought before the next meeting, those present at the past meeting could not complain of the absence of many who were, nevertheless, much missed.

The citizens of Detroit did all that could be expected in the way of social entertainments, excursions, and provision for the meetings, though it was evident, as is often the case, where the Association goes for the first time, that they did not, in general, fully appreciate the importance of the meeting until it had been several days in operation. This was noticeable in the comparatively small attendance of citizens at the several sessions, though it is not to be questioned that quite a number were very much interested, and the seeds sown during the Association week will bear fruit in encouragement to the few workers who have so recently established the very promising and important "Scientific Association of Detroit," and it is certainly no small object gained for the advancement of science if the meetings of the Association thus tend to develop the formation of local societies for scientific research. While speaking thus of the citizens as a whole, it must not be supposed that the usual warm hearted welcome and appreciation, so characteristic of the west, was wanting in a number of gentlemen and ladies of Detroit who entered with spirit into the work and objects of the meeting. The very cordial welcome extended by Mr. Walker, on Wednesday morning, in behalf of the citizens, and the graceful remarks of Mr. Wells at the close of the meeting, both illustrated the interest in, and respect for, the objects which the Association has in view.

The address of the retiring President, Dr. LeConte, is printed in full in this number of the NATURALIST, and we propose to give those of the Vice Presidents in the next.

The results of the donation by Mrs. Thompson were presented to the meeting in the form of a printed quarto volume, containing a Monograph of Fossil Butterflies by Mr. Scudder, and was so

well received that the committee, who have had the matter in charge since the donation was made at the Portland meeting, must have felt satisfied with the performance of their duty.

As was naturally to be expected much feeling was evinced as to the next place of meeting, and the invitations received from Nashville, Philadelphia, and Buffalo were thoroughly discussed. The selection of Buffalo we think is most judicious, as all the benefits of the centennial year will be secured to the Association without the extra expense to the members and the reduction of Scientific work which the selection of Philadelphia would most likely have occasioned. Nashville was asked to keep its invitation open, as the feeling was very strong in favor of an early meeting there as due the Southern members, though for the next year it was felt that advantage should be taken of the great wave that would move from all parts of the country towards Philadelphia, and the meeting should therefore be located at some convenient point to that city. From the former meeting at Buffalo we have every reason to believe that the citizens will be alive to all that is expected of them for the centennial year, and for the quarter centennial (counting by meetings) of the Association, when the members will again assemble under the presidency of Prof. W. B. Rogers, of Boston, who called the Association to order at its first meeting in 1848.

The other officers for the next meeting are C. A. Young, of Hanover, Vice President of Sec. A; E. S. Morse, of Salem, Vice President of Sec. B; G. F. Barker, of Philadelphia, Chairman of Sub-section of Chemistry; L. H. Morgan, of Rochester, Chairman of Sub-section of Anthropology; T. C. Mendenhall, of Columbus, General Secretary; F. W. Putnam, of Salem, Permanent Secretary; A. W. Wright, of New Haven, Secretary of Sec. A; A. H. Tuttle, of Columbus, Secretary of Sec. B; T. T. Bouvé, of Boston, Treasurer. A committee was also appointed for the purpose of obtaining the presence of as many scientists as possible at the next meeting, and another committee was appointed to bring the formation of the Anthropological Sub-section before those specially interested in that department. In this way it is believed that the Association will secure a proper expression of science for the centennial year; and we understand that many of the citizens of Buffalo are resolved to make the meeting an extraordinary one in several particulars.

THE President and Fellows of Harvard College voted, some time since, to accept the fund accumulated by the Agassiz Memorial Committee for the use of the Museum of Comparative Zoölogy. In announcing the acceptance, President Eliot wrote:

"It will be a grateful duty for the President and Fellows, in executing the trust which the Committee have laid upon them, to commemorate the scientific attainments, enthusiasm and devotion of Prof. Agassiz, while they build up and enlarge the Museum of Comparative Zoölogy to the full proportions which his prophetic zeal imagined for it. The continuous growth of the museum is assured through the successful labors of the committee."

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